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NATIONAL DAM SAFETY PROGRAM. G. WILLIAMS DAM (MO 30574), MISSIS--ETC(U)
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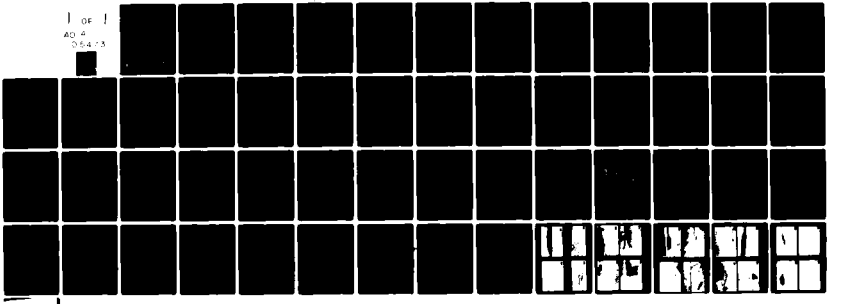

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MISSISSIPPI - KASKASKIA - ST. LOUIS BASIN

AD A105473

G. WILLIAMS DAM

FRANKLIN COUNTY, MISSOURI

MO 30574

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY INSPECTION

United States Army
Corps of Engineers
...Serving the Army
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St. Louis District

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dam Safety, Lake, Dam Inspection, Private Dams

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: G. Williams Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the G. Williams Dam:

It was prepared under the National Program of Inspection of Non-Federal Dams

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

1) Spillway will not pass 50 percent of the Probable Maximum Flood
2) Overtopping could result in dam failure
3) Dam failure significantly increases the hazard to loss of life downstream

SUBMITTED BY: SIGNED
Chief, Engineering Division — 23 AUG 1979 — Date

APPROVED BY: SIGNED
Colonel, CE, District Engineer — 23 AUG 1979 — Date

G. WILLIAMS DAM

FRANKLIN COUNTY, MISSOURI

MISSOURI INVENTORY NO. 30574

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Prepared By

Anderson Engineering, Inc., Springfield, Missouri
Hanson Engineers, Inc., Springfield, Illinois

Under Direction Of

St. Louis District, Corps of Engineers

For

Governor of Missouri

August 1979

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	G. Williams Dam
State Located:	Missouri
County Located:	Franklin
Stream:	Little Meramec River
Date of Inspection:	5-9-79

G. Williams Dam was inspected by an interdisciplinary team of engineers from Anderson Engineering, Inc. of Springfield, Missouri and Hanson Engineers, Inc. of Springfield, Illinois. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers, and they have been developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines, the St. Louis District, Corps of Engineers has determined that this dam is in the high hazard potential classification, which means that loss of life and appreciable property loss could occur if the dam fails. The estimated damage zone extends approximately 3 miles downstream of the dam. Located within this zone are six buildings, eight dwellings and one factory. The dam is in the small size classification, since it is greater than 25 ft high but less than 40 ft high, and the maximum storage capacity is greater than 50 ac-ft but less than 1000 ac-ft.

Our inspection and evaluation indicates that the spillway does not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. The spillway will pass 45 percent of the Probable Maximum Flood without overtopping. The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The guidelines require that a dam of small size with a high downstream hazard potential pass 50 to 100 percent of the PMF. Considering the high hazard potential to loss of life and property downstream of the dam, the PMF has been determined to be the appropriate spillway design flood. The 100-year frequency flood will not overtop the dam. The 100-year flood is one that has a 1 percent chance of being exceeded in any given year.

The embankment appeared to be generally in good condition. Deficiencies visually observed by the inspection

team were: (1) brush and small trees on both faces of the dam, especially on the downstream face near both abutments; (2) a few small trees in the spillway approach channel; and (3) wet areas at the downstream toe in the center of the valley. These wet areas could be due to poor drainage rather than seepage under the dam, but they should be investigated further. Another deficiency was the lack of seepage and stability analysis records.

It is recommended that the owners take the necessary action in the near future to correct the deficiencies reported herein. A detailed discussion of these deficiencies is included in the following report.

Steve Brady, P.E. (AEI)

Gene Wertepny, P.E. (HEI)

Dave Daniels, P.E. (HEI)

Tom Beckley, P.E. (AEI)

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
G. WILLIAMS DAM - ID No. 30574

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APPENDICES

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL:

A. Authority:

The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection be made of G. Williams Dam in Franklin County, Missouri.

B. Purpose of Inspection:

The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and a visual inspection in order to determine if the dam poses hazards to human life or property.

C. Evaluation Criteria:

Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, "Recommended Guidelines for Safety Inspection of Dams, Appendix D." These guidelines were developed with the help of several federal agencies and many state agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT:

A. Description of Dam and Appurtenances:

G. Williams Dam is an earth fill structure approximately 38 ft high and 625 ft long at the crest. The appurtenant works consist of an overflow spillway in the east abutment. The spillway consists of a 24 ft long by approximately 2 ft wide concrete control section (see Photo No. 9 - Appendix D) and a shelved natural rock spillway. An 8 in. diameter steel pipe is provided at station 2+65 to drain the lake. Sheet 3 of Appendix A shows a plan, profile and typical section of the embankment.

B. Location:

The dam is located in the southeast part of Franklin County, Missouri on the Little Meramec River. The dam and lake are within the Lonedell, Missouri 7.5 minute quadrangle sheet (Section 21, T41N, R2E - latitude 38° 16.3'; longitude 90° 48.0'). Sheet 2 of Appendix A shows the general vicinity.

C. Size Classification:

With an embankment height of 38 ft and a maximum storage capacity of approximately 293 acre-ft, the dam is in the small size category.

D. Hazard Classification:

The St. Louis District, Corps of Engineers has classified this dam as a high hazard dam. The estimated damage zone extends approximately 3 miles downstream of the dam. Located within this zone are six buildings, eight dwellings and one factory.

E. Ownership:

The dam is owned by Mr. George H. Williams. The owner's address is P.O. Box 149, St. Clair, Missouri 63077.

F. Purpose of Dam:

The dam was constructed primarily for recreational purposes.

G. Design and Construction History:

No design information or plans are available. The dam was constructed by the owner and completed in 1965. The material for the dam was taken from the lake area. The owner indicated that no significant problems regarding seepage or stability have occurred since the dam was built. He also indicated that the dam has never been overtopped. To our knowledge, no modifications have been made since the original construction.

H. Normal Operating Procedures:

All flows are passed by a rock cut spillway (with a concrete control section) in the east abutment. The owner indicated that the range in water levels has been between 2 ft below and 3 ft above the normal pool level. The most

recent maximum water level occurred in April 1979 (3 ft above normal pool).

1.3 PERTINENT DATA:

Pertinent data about the dam, appurtenant works, and reservoir are presented in the following paragraphs. Sheet 3 of Appendix A presents a plan, profile and typical section of the embankment.

A. Drainage Area:

The drainage area for this dam, as obtained from the Lonedell, Missouri U.S.G.S. quad sheet (1969), is approximately 487 acres.

B. Discharge at Dam Site:

(1) All discharge at the dam site is through an uncontrolled spillway.

(2) Estimated Total Spillway Capacity at Maximum Pool (Top of Dam - El. 682): 1973 cfs

(3) Estimated Experienced Maximum Flood at Dam Site: 440 cfs (Elev. 678)

(4) Diversion Tunnel Low Pool Outlet at Pool Elevation: Not Applicable

(5) Diversion Tunnel Outlet at Pool Elevation: Not Applicable

(6) Gated Spillway Capacity at Pool Elevation: Not Applicable

(7) Gated Spillway Capacity at Maximum Pool Elevation: Not Applicable

C. Elevations: (M.S.L. El. 675 = El. 100 as shown on Sheet 3, Appendix A)

(1) Top of Dam: 682.0 (Low Point); 683 (Ave.)

(2) Spillway Crest: 675.0

(3) Streambed at Centerline of Dam: 645 (Estimated)

(4) Pool on Date of Inspection: 675.1

(5) Maximum Tailwater: Unknown

(6) Upstream Portal Invert Diversion Tunnel: Not Applicable

(7) Downstream Portal Invert Diversion Tunnel: Not Applicable

D. Reservoir Lengths:

(1) At Spillway Crest: 1500 ft

(2) At Top of Dam: 2000 ft

E. Storage Capacities:

(1) At Spillway Crest: 160 Ac-ft

(2) At Top of Dam: 293 Ac-ft

F. Reservoir Surface Areas:

(1) At Spillway Crest: 16 Acres

(2) At Top of Dam: 23 Acres

G. Dam:

(1) Type: Earth Fill

(2) Length at Crest: 625 ft

(3) Height: 38 ft

(4) Top Width: 15 ft

(5) Side Slopes: Upstream 3.0H to 1.0 V; Downstream 3.5H to 1.0V lower part to 2.4H to 1.0V at top (see Sheet 3 of Appendix A)

(6) Zoning: Homogeneous - No Internal Drainage

(7) Impervious Core: None

(8) Cutoff: Key Trench to Rock

(9) Grout Curtain: None

H. Diversion and Regulating Tunnel:

(1) Type: None

(2) Length: Not Applicable

(3) Closure: Not Applicable

(4) Access: Not Applicable

(5) Regulating Facilities: Not Applicable

I. Spillway:

I.1 Principal Spillway:

(1) Location: East Abutment

(2) Type: Shelved into Natural Bedrock with Concrete Control Section

I.2 Emergency Spillway:

(1) Location: None

(2) Type: Not Applicable

J. Regulating Outlets:

(1) An 8 in. diameter steel pipe is located under the dam at station 2+65 for drawdown purposes. The valve for the pipe is located at the downstream end of the dam (see Photo No. 9 - Appendix D)

SECTION 2 - ENGINEERING DATA

2.1 DESIGN:

To our knowledge, no engineering data exist for this dam. No construction inspection records or documented maintenance and operation data exist.

A. Surveys:

To our knowledge, no detailed surveys have been made of the dam. The crest of the concrete control section of the spillway was used as datum for our site survey (Elev. 100). The normal pool of the lake was estimated to be at M.S.L. elevation 675 from the quad sheet, and all elevations used in the report are approximate M.S.L. elevations (El. 100 = 675).

B. Geology and Subsurface Materials:

The site is located at the northeastern edge of the Ozarks. The Ozarks are characterized topographically by hills, plateaus and deep valleys. The most common rock types are dolomite, sandstone and chert. Information from the Missouri Geological Survey indicates that bedrock in the site area is the Roubidoux Formation, which consists of interbedded dolomite, chert and sandstone. The elevation of the top of dam appears to be below the contact with the overlying Jefferson City Formation. The "Geologic Map of Missouri" indicates that the nearest known normal fault runs in a northwest-southeast direction and is at least 3 miles from the site. The Missouri Geological Survey has indicated that the faults in this area are generally considered to be inactive and have been for several hundred million years (rock associated with the Ordovician Period - 500 million years old). The publication "Caves of Missouri" indicates that most of the known caves in Franklin County are in the south-central portion (Meramec Springs State Park and Sullivan quadrangles) and are at least 10 to 15 miles from the site.

The publication "Soils of Missouri" indicates that the soils are of the Union-Fullerton-McGirk soil association which have developed from thin loess deposited over weathered material from cherty limestones and dolomites. The loessial thickness map indicates that upland areas may have

between 2.5 and 5.0 ft of loess cover. Soils in the area of the dam site appear to be primarily thin deposits of residual silty clays with rock fragments.

C. Foundation and Embankment Design:

No design computations are available. Information from the owner indicates that the dam is composed of materials taken from the lake area upstream of the dam. Our site inspection indicates that these materials are probably primarily residual silty clays with rock fragments. The owner indicated that a core trench to rock was incorporated under the dam. No internal drainage features were incorporated, nor is there any particular zoning of the embankment. No construction inspection records are available.

D. Hydrology and Hydraulics:

No hydrologic or hydraulic design data were obtained. Our analyses of the PMF are presented in Appendix C. These analyses were based on our field survey and observations, and estimates of areas and volumes from the U.S.G.S. quad sheet. It was concluded that the structure will pass 45 percent of the Probable Maximum Flood without overtopping. The 100-year frequency flood will not overtop the dam.

E. Structure:

The only appurtenant structures are the 8 in. diameter drawdown pipe with the valve at the downstream end, and the concrete control section for the spillway. The owner indicated that the drawdown pipe was used once several years ago and that the lake was drawn down 5 ft or 6 ft in 2 weeks. It is not known whether the drawdown pipe has anti-seep collars. The concrete control section has been undermined to some extent but does not appear to be unstable at this time. No design information is available.

2.2 CONSTRUCTION:

No construction inspection data have been obtained.

2.3 OPERATION AND MAINTENANCE:

To our knowledge, there are no operating records. The owner indicated that trees and brush on the dam are cut every few years.

2.4 EVALUATION:

A. Availability:

No engineering data, seepage or stability analyses, or construction test data were available.

B. Adequacy:

The engineering data available were inadequate to make a detailed assessment of the design, construction, and operation of this structure. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

C. Validity:

To our knowledge, no valid engineering data on the design or construction of the embankment are available.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS:

A. General:

The field inspection was made on May 9, 1979. The inspection team consisted of personnel from Anderson Engineering, Inc. of Springfield, Missouri and Hanson Engineers, Inc. of Springfield, Illinois. The team members were:

Steve Brady - Anderson Engineering, Inc. (Civil Engineer)
Tom Beckley - Anderson Engineering, Inc. (Civil Engineer)
Gene Wertepny - Hanson Engineers, Inc. (Hydraulic Engineer)
Dave Daniels - Hanson Engineers, Inc. (Geotechnical Engineer)

B. Dam:

The dam appears to be generally in good condition. No sloughing or obvious seepage through the embankment was noted. The dam appears to have been constructed on a slight curve which is concave to the downstream direction. The dam is fairly level across the crest, and no surface cracking or unusual movement was obvious. Shallow auger probes into the embankment indicated the embankment to consist of a red-brown residual silty clay with rock fragments.

Light brush and small trees were noted on both faces of the dam. Fairly heavy brush exists on the downstream face approximately 100 ft from both abutments. Slight erosion was noted at both downstream abutment-dam contacts. No animal burrows were noted, although some could exist in the areas of heavy brush, which were not detected. The front face of the dam has riprap, which extends to a level within 2 ft to 3 ft below the crest. The riprap appeared to be reasonably intact. The riprap consisted of fairly large limestone rock (1 ft to 2 ft in size).

Wet areas with reeds and cattails were noted at the toe of the dam and in the floodplain downstream as shown on Sheet 4 of Appendix A. These areas could be the result of back-up of the small pond located at the base of the dam (pond used to water cattle) and poor drainage. It is also possible that some leakage could be occurring under the dam in the area of the old streambed.

No instrumentation (monuments, piezometers, etc.) was observed.

C. Appurtenant Structures:

C.1 Primary Spillway:

The approach to the spillway has a few small trees. The concrete control section is undermined somewhat but appears to be stable at this time. The control section should be inspected periodically to be sure that it does not become unstable in the future. The spillway downstream of the control section is well away from the dam itself, and its base is cut primarily in natural bedrock. The spillway is fairly free of debris and vegetation downstream of the control section.

C.2 Emergency Spillway:

There is no emergency spillway associated with this dam.

D. Reservoir:

The watershed has some woods but is primarily pasture-land. The slopes adjacent to the lake are moderate, and no sloughing or serious erosion was noted. The owner indicated no problems in regards to siltation.

E. Downstream Channel:

Spillway discharge flows over a series of rock falls to reach the original channel, which is near the center of the valley. The rock types seen in the spillway were limestone, sandstone and shale.

3.2 EVALUATION:

Trees and brush on the dam should be cleared on an annual basis. Trees in the approach to the spillway should be removed. Erosional areas at dam-abutment contacts should be corrected and maintained. The wet areas (possible under-seepage) at the downstream toe should be investigated by an engineer experienced in the design and construction of dams.

Because the valve of the lake drain is located on the downstream side of the dam, the full head of water impounded by the dam is acting entirely through the dam. The area around the lake drain outlet should be periodically inspected for seepage which might indicate a leak or rupture of the drain pipe which could eventually initiate a piping failure through the embankment.

Photographs of the dam, appurtenant structures, the reservoir and a part of the drainage basin above and below the dam are presented in Appendix D.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES:

There are no controlled outlet works for this dam except for the 8 in. diameter drawdown pipe, which is apparently used very infrequently. The spillway is uncontrolled, so that the pool is normally controlled by rainfall, runoff and evaporation.

4.2 MAINTENANCE OF DAM:

The owner indicated that brush and trees on the dam are cut every few years.

4.3 MAINTENANCE OF OPERATING FACILITIES:

Although the drawdown facilities appear to be in good condition, it is not known whether they are regularly maintained.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT:

The inspection team is unaware of any existing warning system for this dam.

4.5 EVALUATION:

Vegetation on the dam should be cut annually. Erosional areas at the dam-abutment contacts should be corrected and maintained.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES:

A. & B. Design and Experience Data:

The hydraulic and hydrologic analyses were based on: (1) a field survey of spillway dimensions and embankment elevations; and (2) an estimate of the pool and drainage areas from the U.S.G.S. quad sheet. No previous hydraulic or hydrologic studies were obtained. Our hydrologic and hydraulic analyses using U.S. Army Corps of Engineers guidelines appear in Appendix C.

C. Visual Observations:

The approach to the spillway at the east abutment should be cleared of small trees. Some erosion protection would appear to be advisable in the approach area on the west side (embankment side). The concrete control section is somewhat undermined but does not appear to be unstable at this time. The control section should be inspected periodically to be sure that it does not become unstable in the future.

The spillway downstream of the control section flows on natural bedrock and is relatively free of debris and vegetation. The spillway is well away from the dam, and spillway releases would not be expected to endanger the dam.

D. Overtopping Potential:

Based on the hydrologic and hydraulic analysis presented in Appendix C, the spillway will pass 45 percent of the Probable Maximum Flood. The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The recommended guidelines from the Department of the Army, Office of the Chief of Engineers, require that this structure (small size with high downstream hazard potential) pass 50 to 100 percent of the PMF, without overtopping. Considering the high hazard potential to loss of life and property downstream of the dam, the PMF has been determined to be the appropriate spillway design flood. The structure will pass a 100-year frequency flood without overtopping.

The routing of the PMF through the spillway and dam indicates that the dam will be overtopped by 1.79 ft at elevation 683.79. The duration of the overtopping will be 1.33 hours, and the maximum outflow will be 7438 cfs. The routing of 50 percent of the PMF through the spillway and dam indicates that the dam will be overtopped by 0.43 ft at elevation 682.43. The duration of the overtopping will be 0.42 hours, and the maximum outflow will be 2713 cfs. The maximum discharge capacity of the spillway is 1973 cfs. Overtopping of an earthen embankment could cause serious erosion and could possibly lead to failure of the structure. The residual silty clays which appear to make up the dam are generally not considered to be highly erodible materials.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY:

A. Visual Observations:

Physical factors observed which could adversely affect the structural stability of this dam are discussed in Sections 3.1B and 3.2.

B. Design and Construction Data:

No design and construction data for the foundation and embankment were available. Seepage and stability analyses comparable to the requirements of the guidelines were not available, which constitutes a deficiency which should be rectified.

C. Operating Records:

No operating records have been obtained.

D. Post-Construction Changes:

The inspection team is not aware of any post-construction changes to the dam.

E. Seismic Stability:

The structure is located in seismic zone 1. An earthquake of this magnitude would not generally be expected to cause severe structural damage to a well constructed earth dam of this size. However, it is recommended that the prescribed seismic loading for this zone be applied in stability analyses performed for this dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT:

This Phase I inspection and evaluation should not be considered as being comprehensive since the scope of work contracted for is far less detailed than would be required for an in-depth evaluation of dams. Latent deficiencies, which might be detected by a totally comprehensive investigation, could exist.

A. Safety:

The embankment is generally in good condition. However, several items were noted during the visual inspection which should be investigated further, corrected or controlled. These items are: (1) brush and tree growth on the dam; (2) minor erosion at the dam-abutment contacts; (3) possible seepage (wet areas) at the downstream toe; (4) undermining of the concrete control section; and (5) small tree growth in the approach to the spillway and lack of erosion protection on the west side (embankment side) in the approach area.

The dam will be overtopped by flows in excess of 45 percent of the Probable Maximum Flood. Overtopping of an earthen embankment could cause serious erosion and could possibly lead to failure of the structure. The residual silty clays which appear to make up the dam are generally not considered to be highly erodible materials.

B. Adequacy of Information:

The conclusions in this report were based on the performance history as related by others, and visual observation of external conditions. The inspection team considers that these data are sufficient to support the conclusions herein. Seepage and stability analyses comparable to the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

C. Urgency:

The remedial measures recommended in paragraph 7.2 should be accomplished in the near future. If the deficiencies listed in paragraph A are not corrected, and if good maintenance is not provided, the embankment condition will deteriorate and possibly could become serious in the future. Priority should be given to increasing the size of the spillway.

D. Necessity for Phase II:

Based on the result of the Phase I inspection, no Phase II inspection is recommended.

E. Seismic Stability:

The structure is located in seismic zone 1. An earthquake of this magnitude would not generally be expected to cause severe structural damage to a well constructed earth dam of this size. However, it is recommended that the prescribed seismic loading for this zone be applied in any stability analyses performed for this dam.

7.2 REMEDIAL MEASURES:

The following remedial measures and maintenance procedures are recommended. All remedial measures should be performed under the guidance of a professional engineer experienced in the design and construction of dams.

(1) Spillway size and/or height of dam should be increased to pass the PMF. In either case, the spillway should be protected to prevent erosion.

(2) Seepage and stability analyses comparable to the requirements of the recommended guidelines should be performed by an engineer experienced in the construction of dams.

(3) Brush and tree growth should be removed from the dam and from the approach to the spillway. This should be done under the guidance of a professional engineer experienced in the design and construction of dams. Indiscriminate clearing methods could jeopardize the safety of the dam. It would also appear advisable to provide some erosion protection in the spillway approach area on the west side (embankment side).

(4) Erosional areas at dam-abutment contacts should be corrected and maintained.

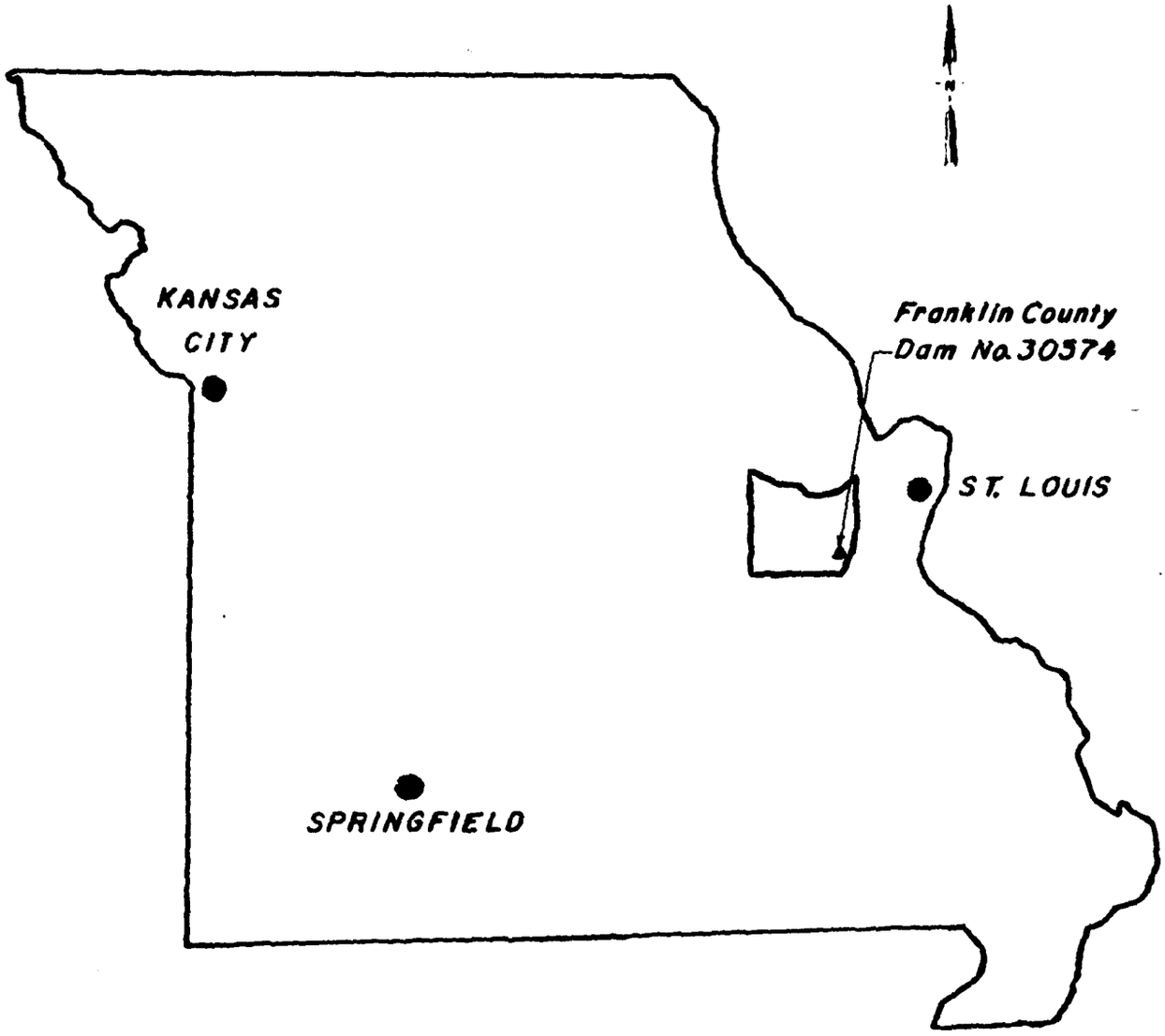
(5) The possible seepage area at the downstream toe should be evaluated by an engineer experienced in the design of dams.

(6) The concrete control section should be inspected periodically and stabilized if necessary, even though its failure would probably not cause a catastrophic failure of the dam.

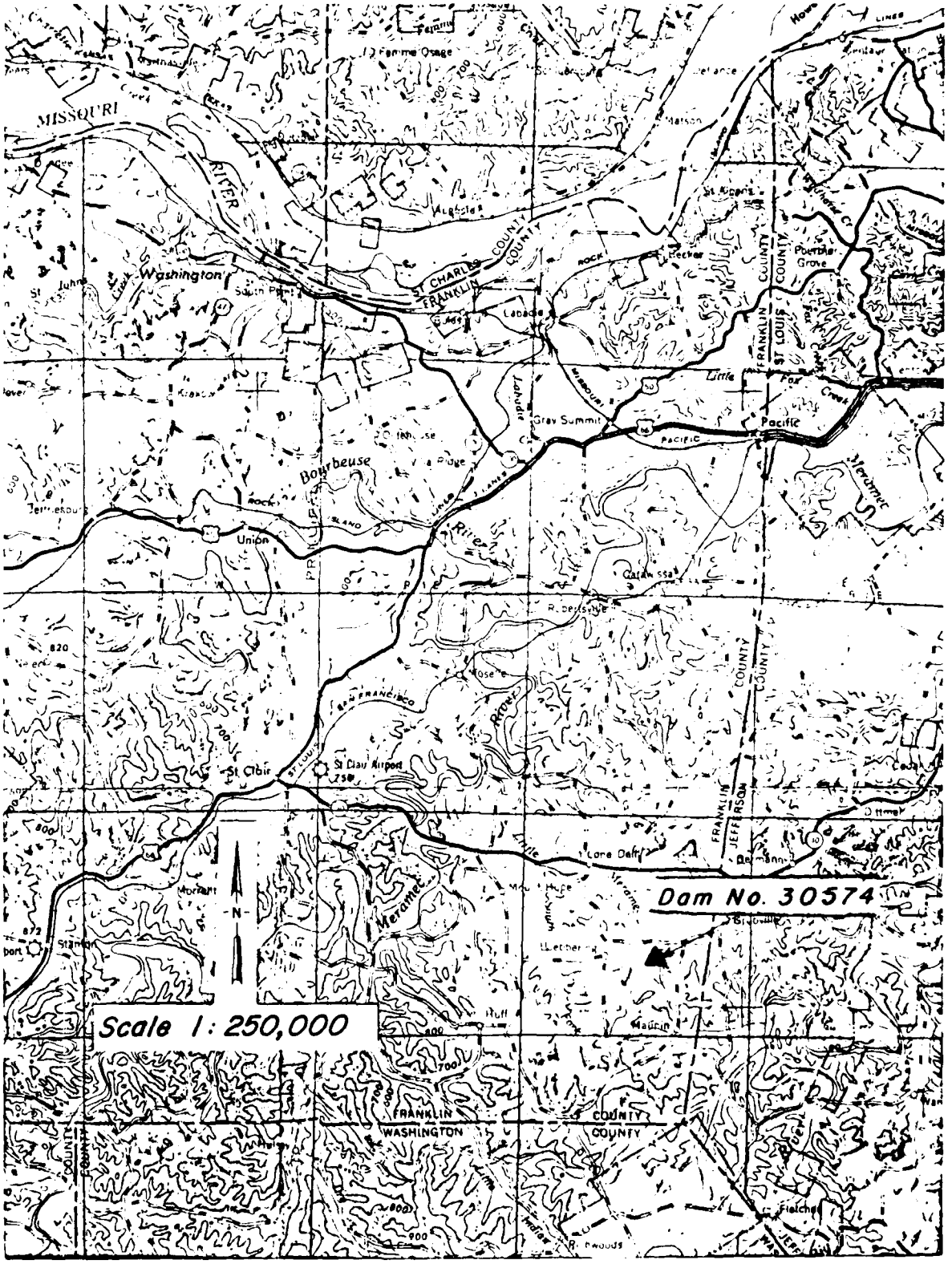
(7) A detailed inspection of the dam should be made periodically by an engineer experienced in the design and construction of dams.

(8) The valve on the drawdown pipe should be opened periodically to insure that it is operable.

APPENDIX A

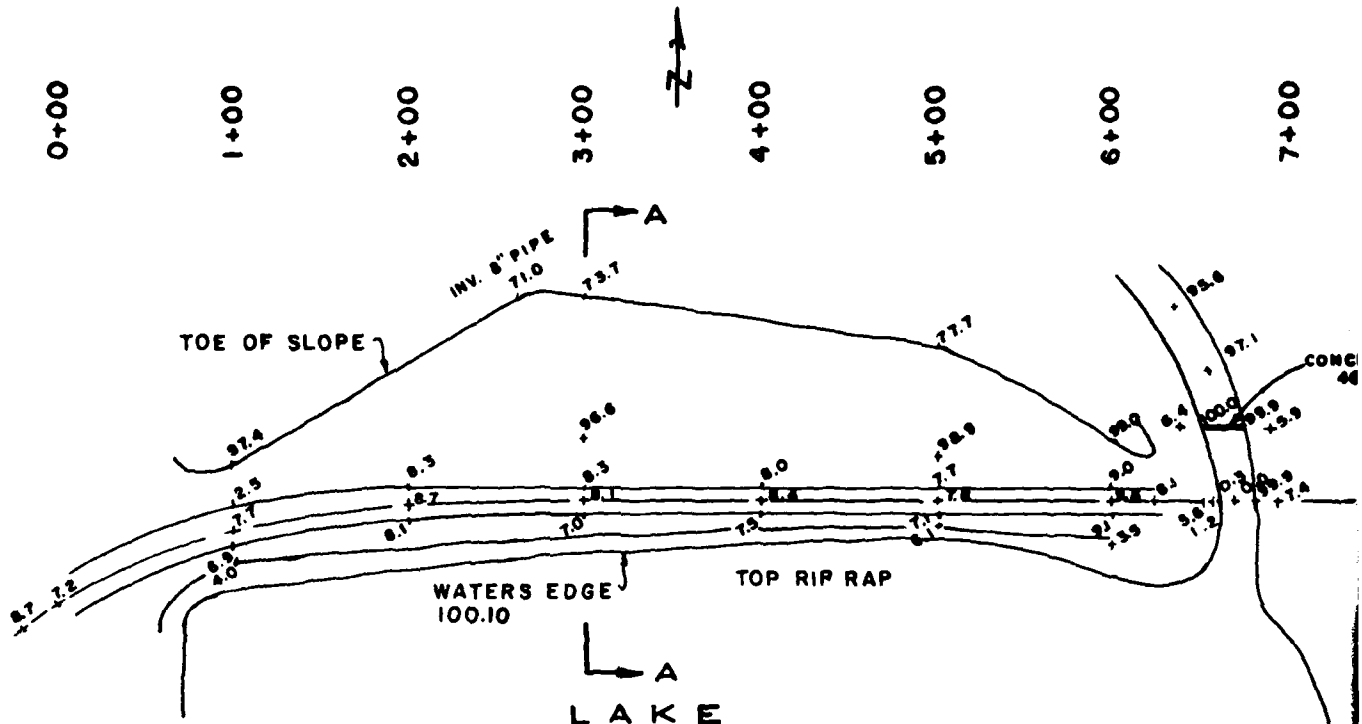


LOCATION MAP



SITE VICINITY MAP

Sheet 2 Appendix A

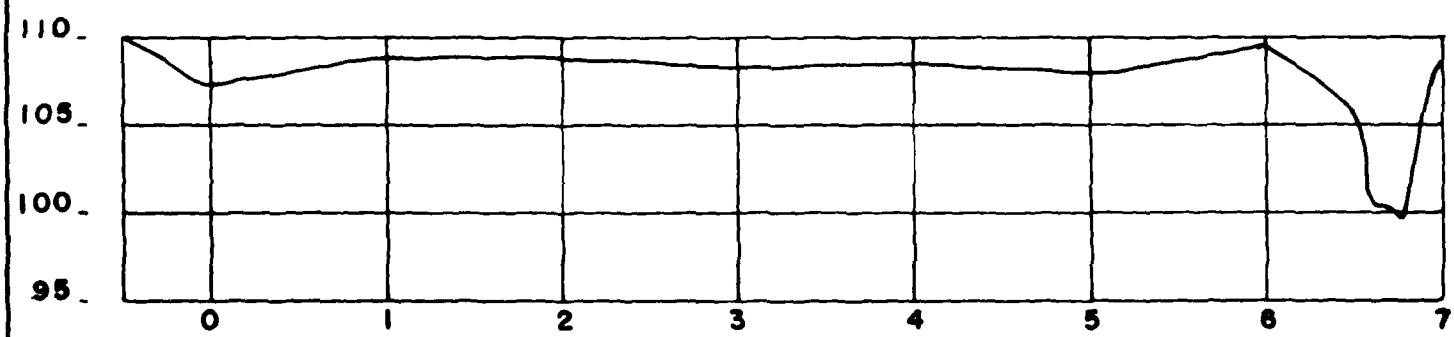


NOTE: ADD 100.00 TO ALL SPOT ELEVATIONS SHOWN ON PLAN VIEW.

BENCHMARK:
TOP WESTEND CONCRETE SPILLWAY
(ASSUMED 100.00)

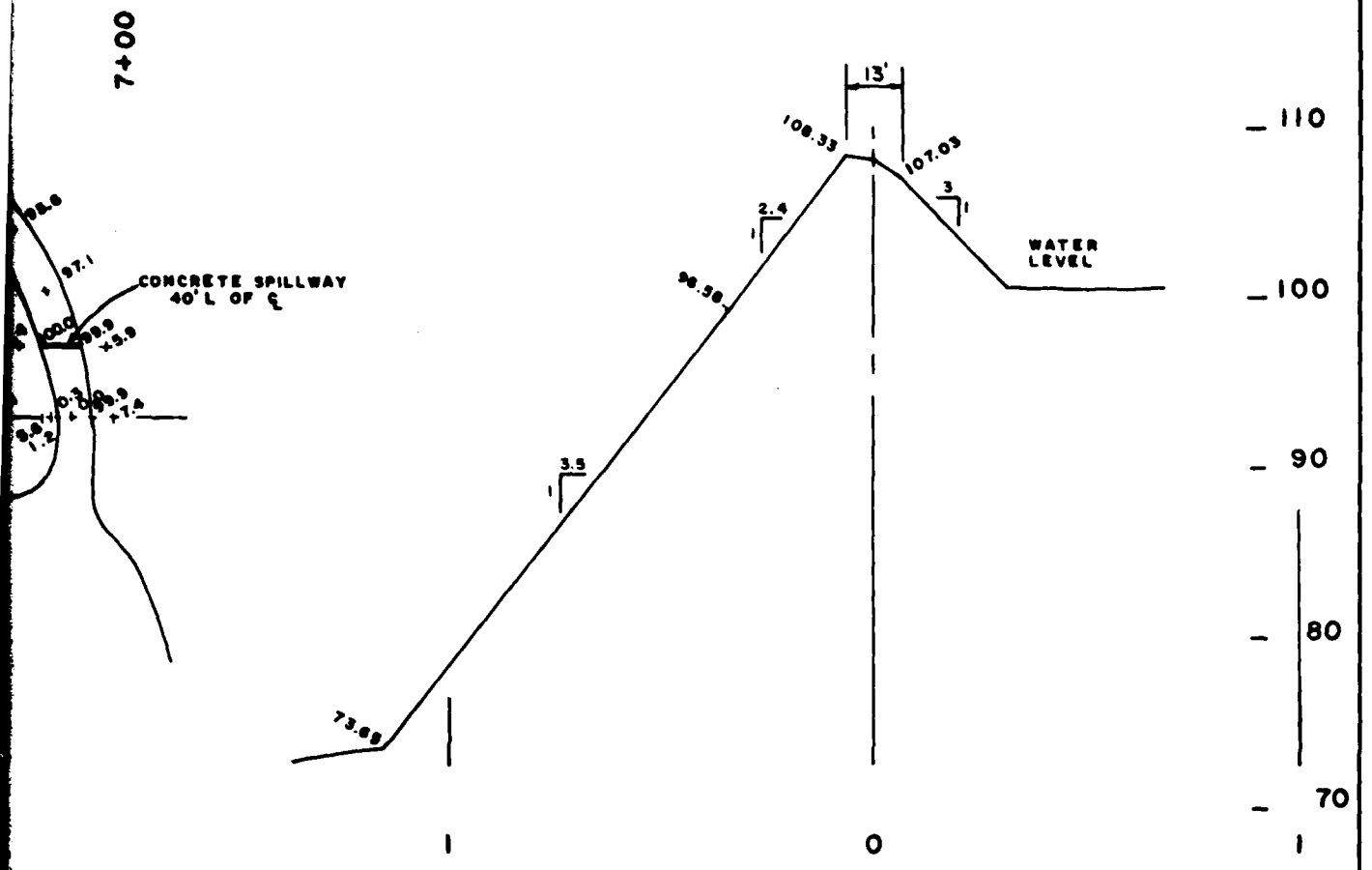
PLAN VIEW

SCALE: 1" = 100'

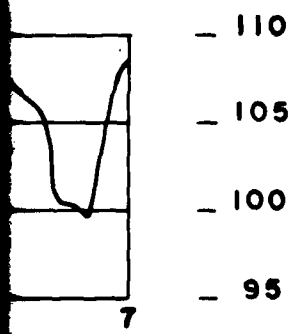


PROFILE

NOTE: NORMAL POOL ESTIMATED FROM QUAD SHEET AT 675 FT. ABOVE M.S.L. SITE SURVEY EL. 100 = EL. 675.



SECTION A-A STA 3+00



SHEET 3 APPENDIX A

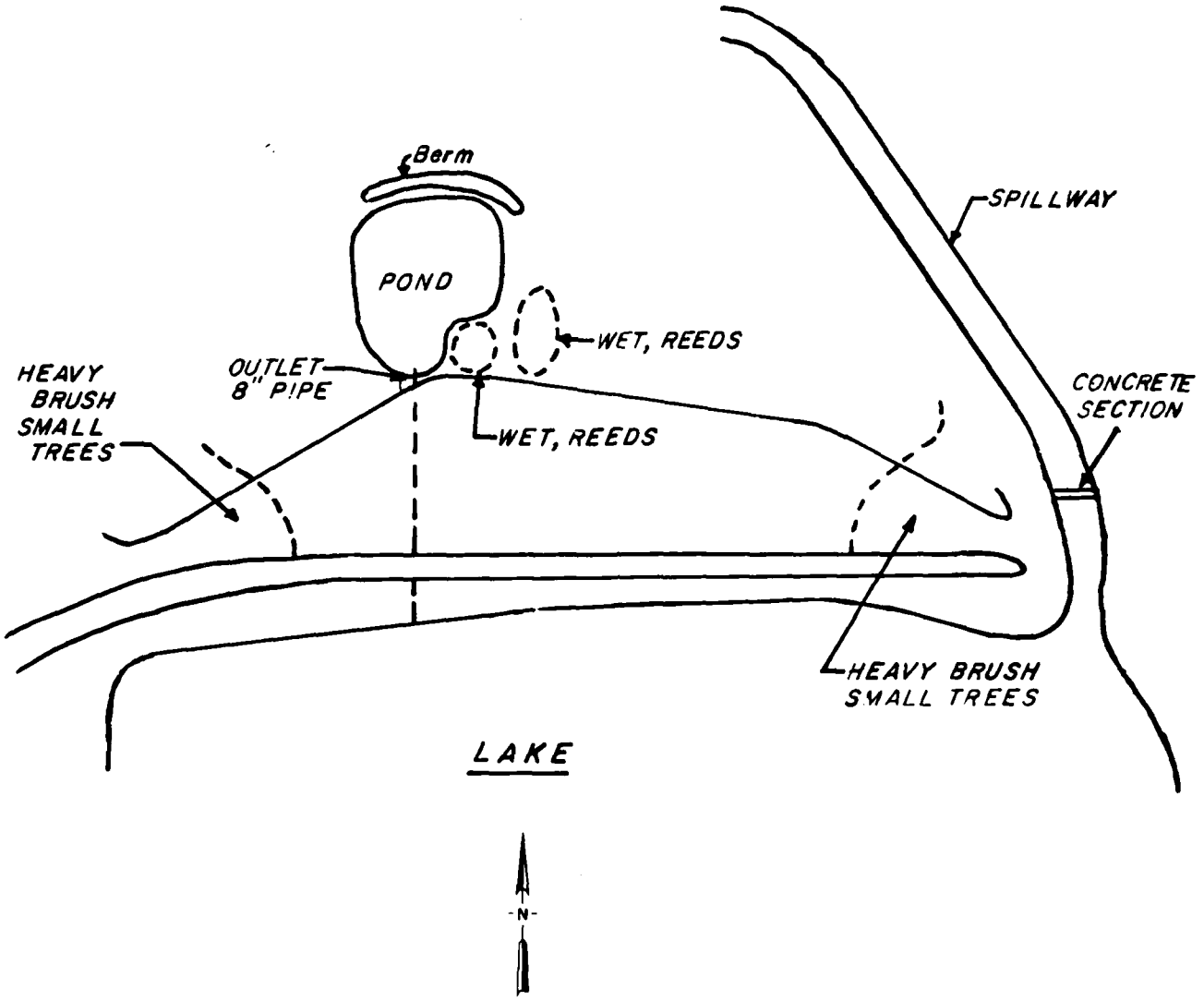
ANDERSON ENGINEERING, INC.
730 NORTH BENTON AVENUE
SPRINGFIELD, MISSOURI 65802

G. WILLIAMS DAM

MO. No. 30574

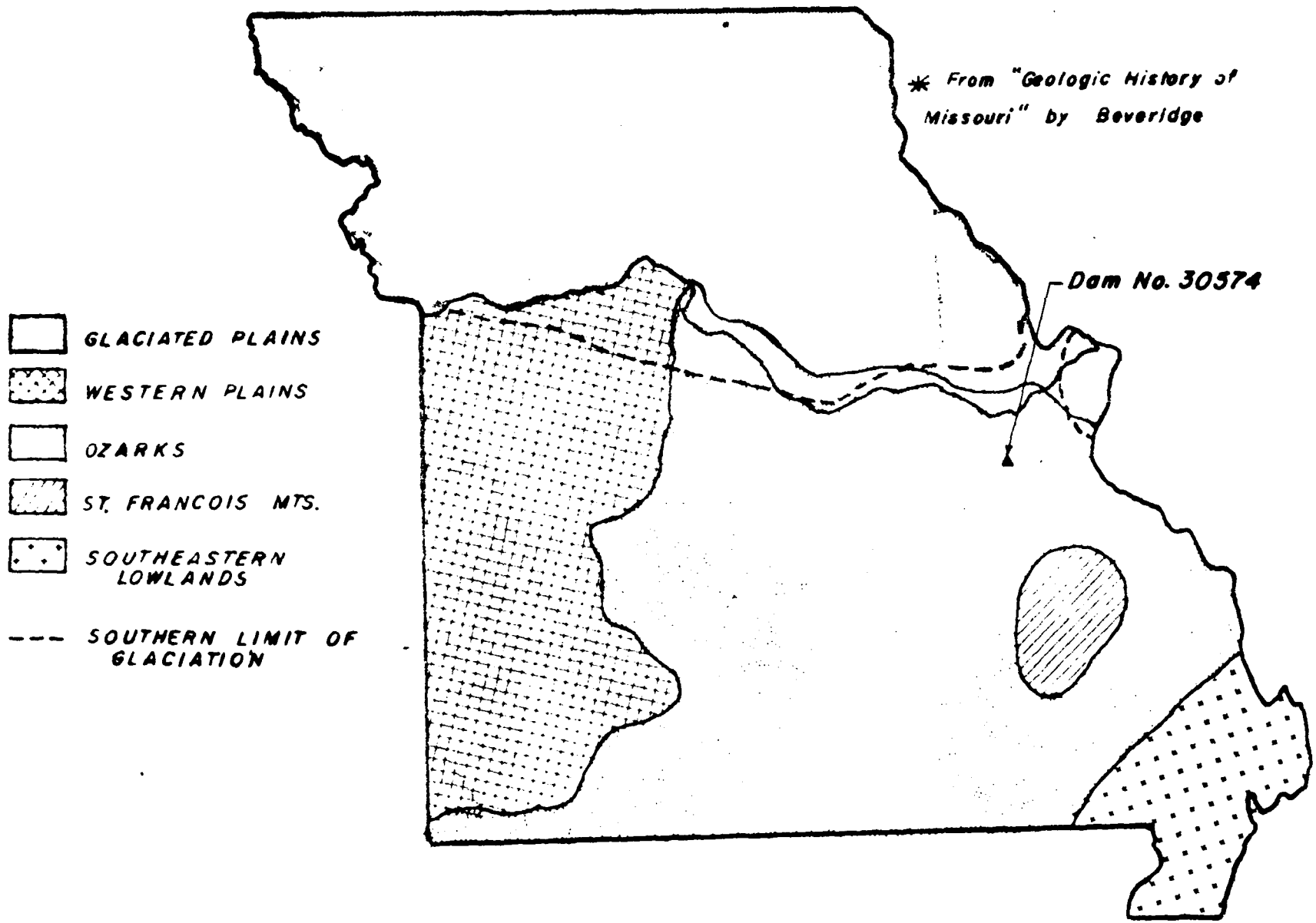
PLAN & PROFILE

FRANKLIN COUNTY, MO.

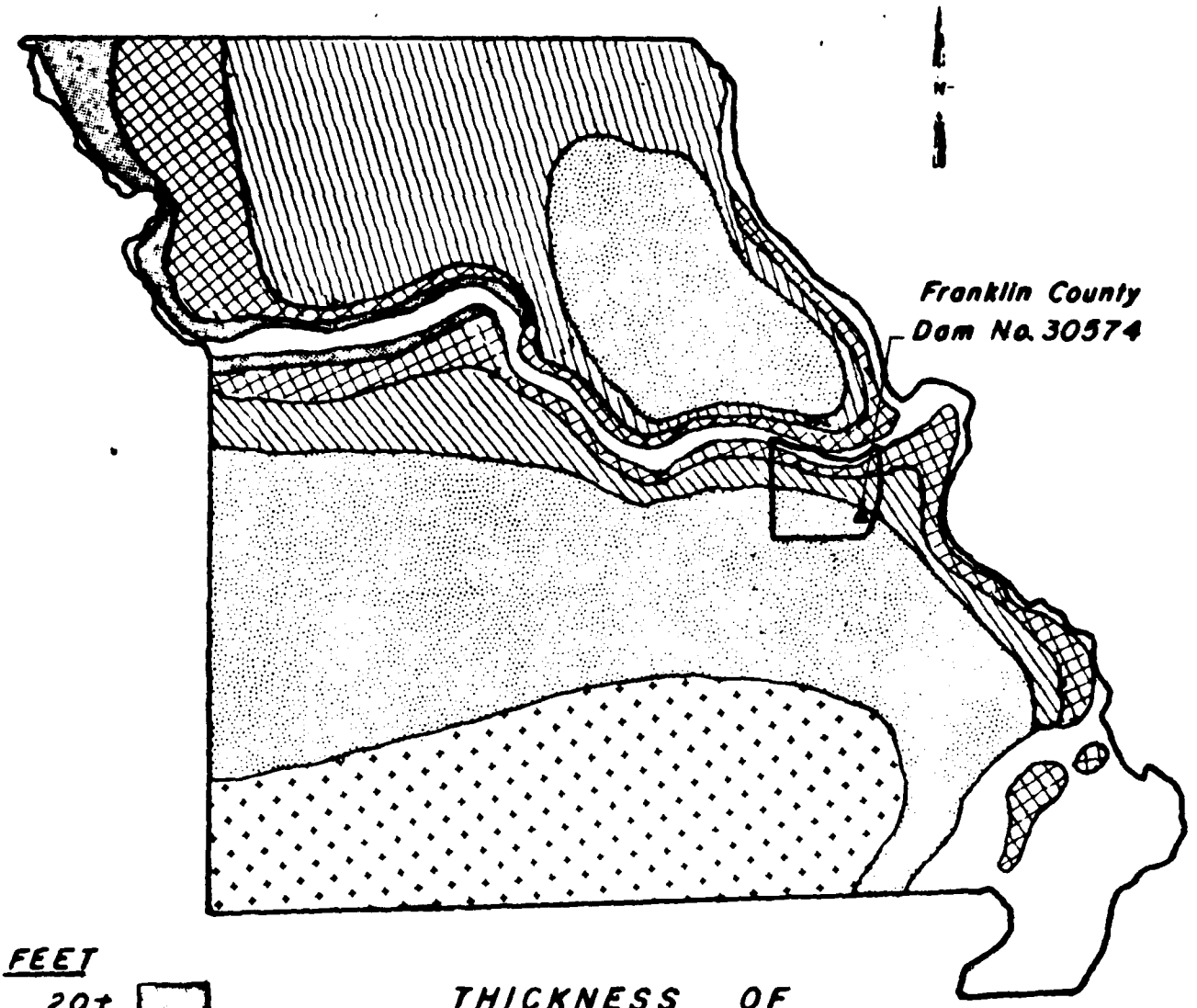

Berm
POND
SPILLWAY
WET, REEDS
HEAVY BRUSH SMALL TREES
OUTLET 8" PIPE
WET, REEDS
CONCRETE SECTION
HEAVY BRUSH SMALL TREES
LAKE
N

APPENDIX B

MAJOR GEOLOGIC REGIONS OF MISSOURI



* From "Soils of Missouri"



FEET

20+

10-20

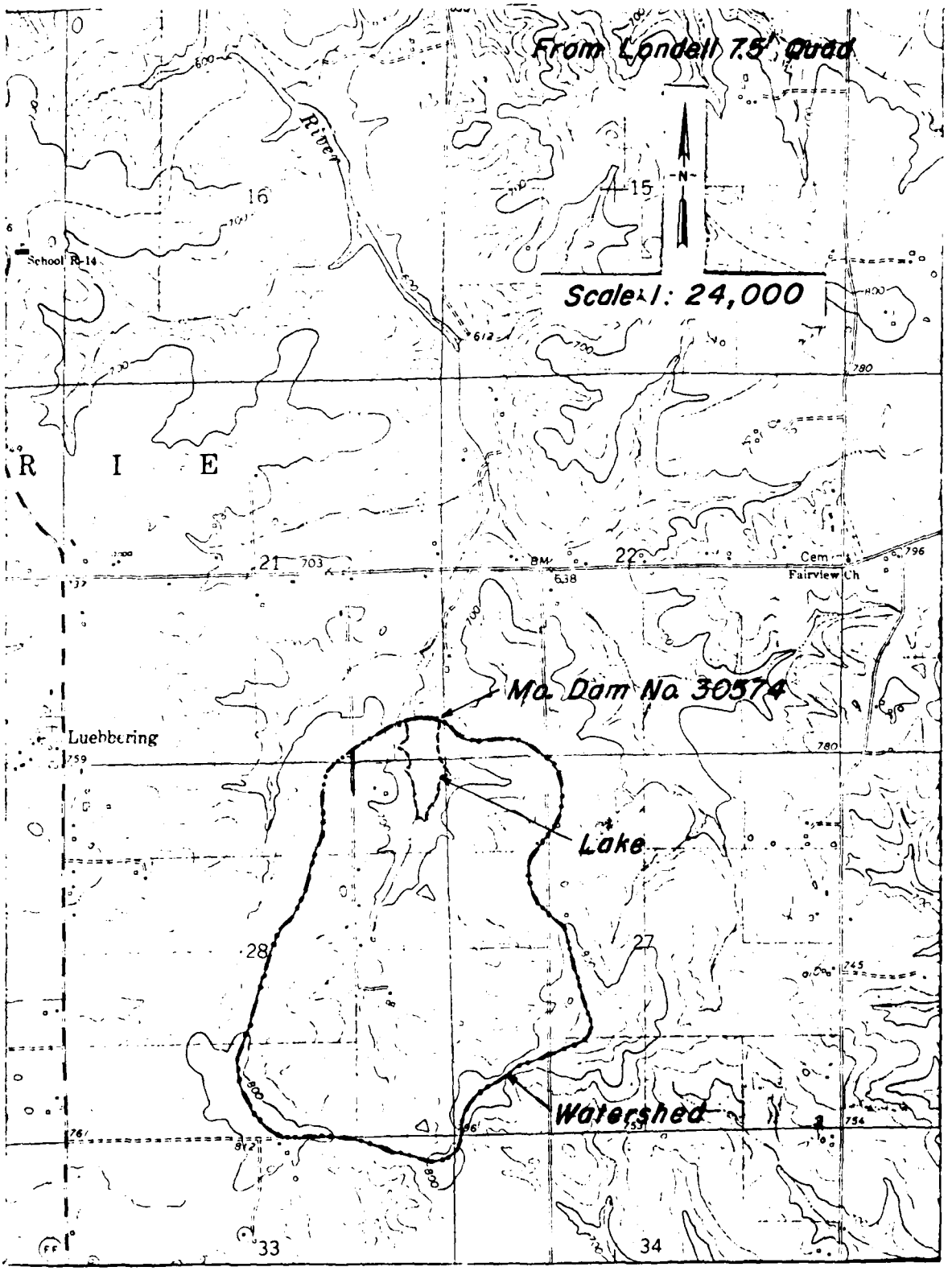
5-10

2.5-5

2.5-

THICKNESS OF LOESSIAL DEPOSITS

APPENDIX C



LAKE AND WATERSHED MAP

Sheet 1 Appendix C

HYDRAULIC AND HYDROLOGIC DATA

Design Data: From Field Measurements and Computations

Experience Data: No records are available. The owner indicated that the range in water levels has been between 2 ft below and 3 ft above the normal pool level. He also indicated that the dam has never been overtopped.

Visual Inspection: At the time of the inspection, the pool level was approximately 0.1 ft above normal pool.

Overtopping Potential: Flood routing studies were performed to determine the overtopping potential of the dam. Since the dam is of small size with a high hazard rating, a spillway design storm of 50 to 100 percent Probable Maximum Flood was prescribed by the guidelines. Considering the high hazard potential to loss of life and property downstream of the dam, the PMF has been determined to be the appropriate spillway design flood. The PMF is defined by the guidelines as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The watershed drainage and the reservoir surface areas were obtained by planimeter from the U.S.G.S. 7.5 min. Lonedell, Mo. quadrangle map. The reservoir area elevation relationship was developed from these data.

A 5 minute interval unit graph was developed for this watershed which resulted in a peak inflow of 1278 c.f.s. and a time to peak of 15 minutes. Application of the probable maximum precipitation, minus losses resulted in a flood hydrograph peak inflow of 7915 c.f.s. Rainfall distribution for the 24 hour storm was according to EM 1110-2-1411.

The routing of the PMF through the spillway and dam indicates that the dam will be overtopped by 1.79 ft at elevation 683.79. The duration of the overtopping will be 1.33 hours, and the maximum outflow will be 7438 cfs. The maximum discharge capacity of the spillway is 1973 cfs. Analysis of the routing results indicates that the structure will pass the 100-year frequency flood and 45 percent of the PMF without overtopping.

OVERTOPPING ANALYSIS FOR G. WILLIAMS DAM

INPUT PARAMETERS

1. Unit Hydrograph - SCS Dimensionless - Flood Hydrograph Package (HEC-1); Dam Safety Version Was Used.
   Hydraulic Inputs Are As Follows:

   a. Twenty-four Hour Rainfall of 25.6 Inches For 200 Square Miles - All Season Envelope

   b. Drainage Area = 487 Acres; = 0.76 Sq. Miles

   c. Travel Time of Runoff 0.40 Hrs.; Lag Time 0.24 Hrs.

   d. Soil Conservation Service Soil Group C Union-Fullerton McGirk

   e. Soil Conservation Service Runoff Curve No. 88 (AMC III)

   f. Proportion of Drainage Basin Impervious 0.04

2. Spillways

   a. Primary Spillway: Concrete Weir (2 ft thick) concrete wall), crest El. 675.0, crest length = 24 ft, trapezoidal section, side slopes 2:1

   b. Emergency Spillway: None

      Length -- Ft.; Side Slopes --; C = --

   c. Dam Overflow

      Length 625 Ft.; Crest El. 0; C = 3.0

3. Spillway and Dam Rating:

   Curve Prepared by Hanson Engineers. Data Provided To Computer on Y4 and Y5 Cards.
   Formula Used: $Q^2/g = A^3/T$

Note: Time of Concentration From Equation $Tc = \left(\frac{11.9\ L^3}{H}\right)^{.385}$

California Culvert Practice, California Highways and Public Works, Sept. 1942.

SUMMARY OF DAM SAFETY ANALYSIS

1. Unit Hydrograph

   a. Peak - 1278 c.f.s.

   b. Time to Peak 15 Min.

2. Flood Routings Were Computed by the Modified Puls Method

   a. Peak Inflow

      50% PMF 3957 c.f.s.; 100% PMF 7915 c.f.s.

   b. Peak Elevation

      50% PMF 682.43 100% PMF 683.79

   c. Portion of PMF That Will Reach Top of Dam

      45%; Top of Dam Elev. 682.0 Ft.

3. Computer Input and Output Data are shown on Sheets 5 and 6 of this Appendix.

```
A       OVERTOPPING ANALYSIS FOR G. WILLIAMS DAM (#27)
A       STATE ID NO. 30574 CO. NO. 071 CO NAME FRANKLIN
A       HANSON ENGINEERS INC. DAM SAFETY INSPECTION JOB #79511
B    300                5
B1     5
J      1        7        1
J1   .15      .20      .30      .40      .50      .75      1.0
K      0        1                                  0        1
K1       INFLOW HYDROGRAPH COMPUTATION
M      1        2     0.76              0.76        1                          1
P      0     25.6      102      120      130
T                                                            -1       -88               0.04
U2  0.40     0.24
X      0       -.1        2
K      1        2                            2        0        1
K1       RESERVOIR ROUTING BY MODIFIED PULS AT DAM SITE
Y                                    1        1
Y1     1                                                    160       -1
Y4   675      676      677      678      679      680      681      683      684
Y5     0       75      230      440      730     1060     1480     2465     3050
$A     0       16     20.2     53.3
$E   645      675      680      700
$$   675
$D   682      3.0      1.5      625
K     99
```

********** ********** ********** ********** **********

1

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

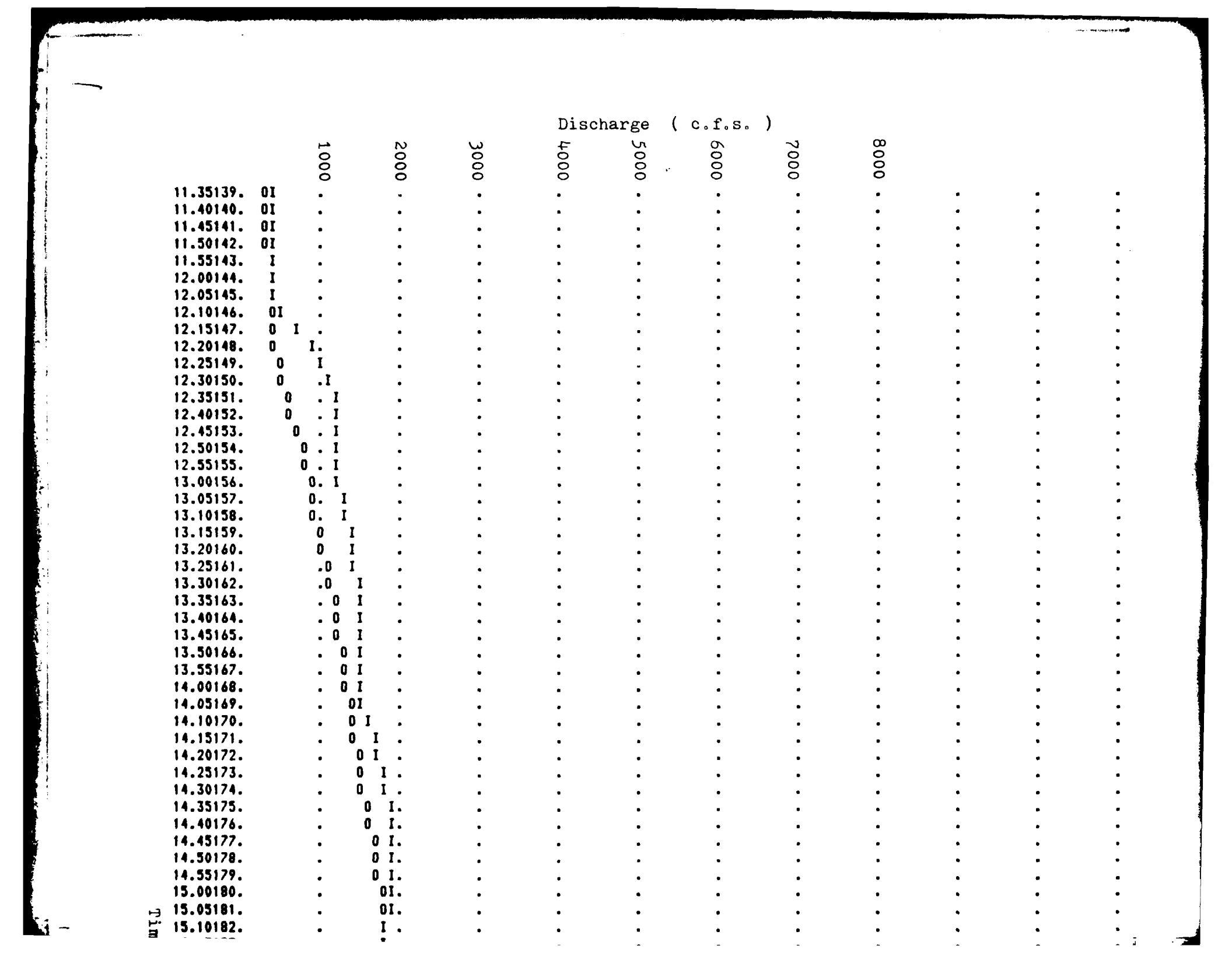
				RATIOS APPLIED TO FLOWS						
OPERATION	STATION	AREA	PLAN	RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7
				0.15	0.20	0.30	0.40	0.50	0.75	1.00
HYDROGRAPH AT	1	0.76	1	1187.	1583.	2374.	3166.	3957.	5936.	7915.
	(	1.97)	(	33.62)(	44.82)(	67.24)(	89.65)(	112.06)(	168.09)(	224.12)(
ROUTED TO	2	0.76	1	561.	790.	1278.	1788.	2713.	5334.	7438.
	(	1.97)	(	15.88)(	22.36)(	36.19)(	50.63)(	76.83)(	151.04)(	210.63)(

1 *SUMMARY OF DAM SAFETY ANALYSIS*

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	675.00	675.00	682.00
STORAGE	160.	160.	293.
OUTFLOW	0.	0.	1973.

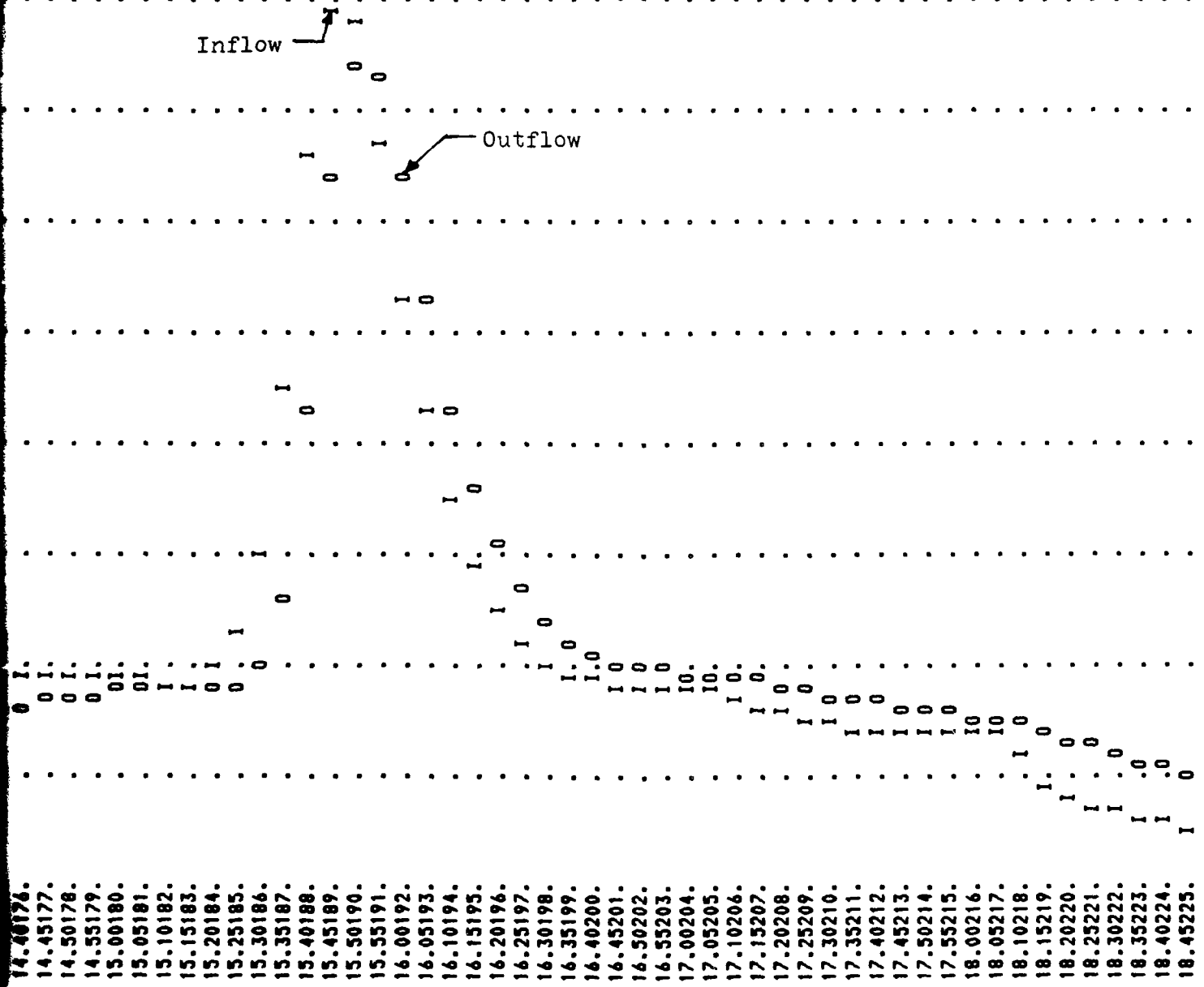
RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.15	678.42	0.00	219.	561.	0.00	16.17	0.00
0.20	679.18	0.00	234.	790.	0.00	16.08	0.00
0.30	680.52	0.00	261.	1278.	0.00	16.08	0.00
0.40	681.63	0.00	285.	1788.	0.00	16.08	0.00
0.50	682.43	0.43	303.	2713.	0.42	16.00	0.00
0.75	683.27	1.27	323.	5334.	0.83	15.92	0.00
1.00	683.79	1.79	336.	7438.	1.33	15.83	0.00


Discharge (c.f.s.)
1000
2000
3000
4000
5000
6000
7000
8000
11.35139.
11.40140.
11.45141.
11.50142.
11.55143.
12.00144.
12.05145.
12.10146.
12.15147.
12.20148.
12.25149.
12.30150.
12.35151.
12.40152.
12.45153.
12.50154.
12.55155.
13.00156.
13.05157.
13.10158.
13.15159.
13.20160.
13.25161.
13.30162.
13.35163.
13.40164.
13.45165.
13.50166.
13.55167.
14.00168.
14.05169.
14.10170.
14.15171.
14.20172.
14.25173.
14.30174.
14.35175.
14.40176.
14.45177.
14.50178.
14.55179.
15.00180.
15.05181.
15.10182.
Tim

INFLOW - OUTFLOW
HYDROGRAPH
FOR 100% P. M. F.

Max. Inflow = 7,915 c.f.s.

Max. Outflow = 7,438 c.f.s.

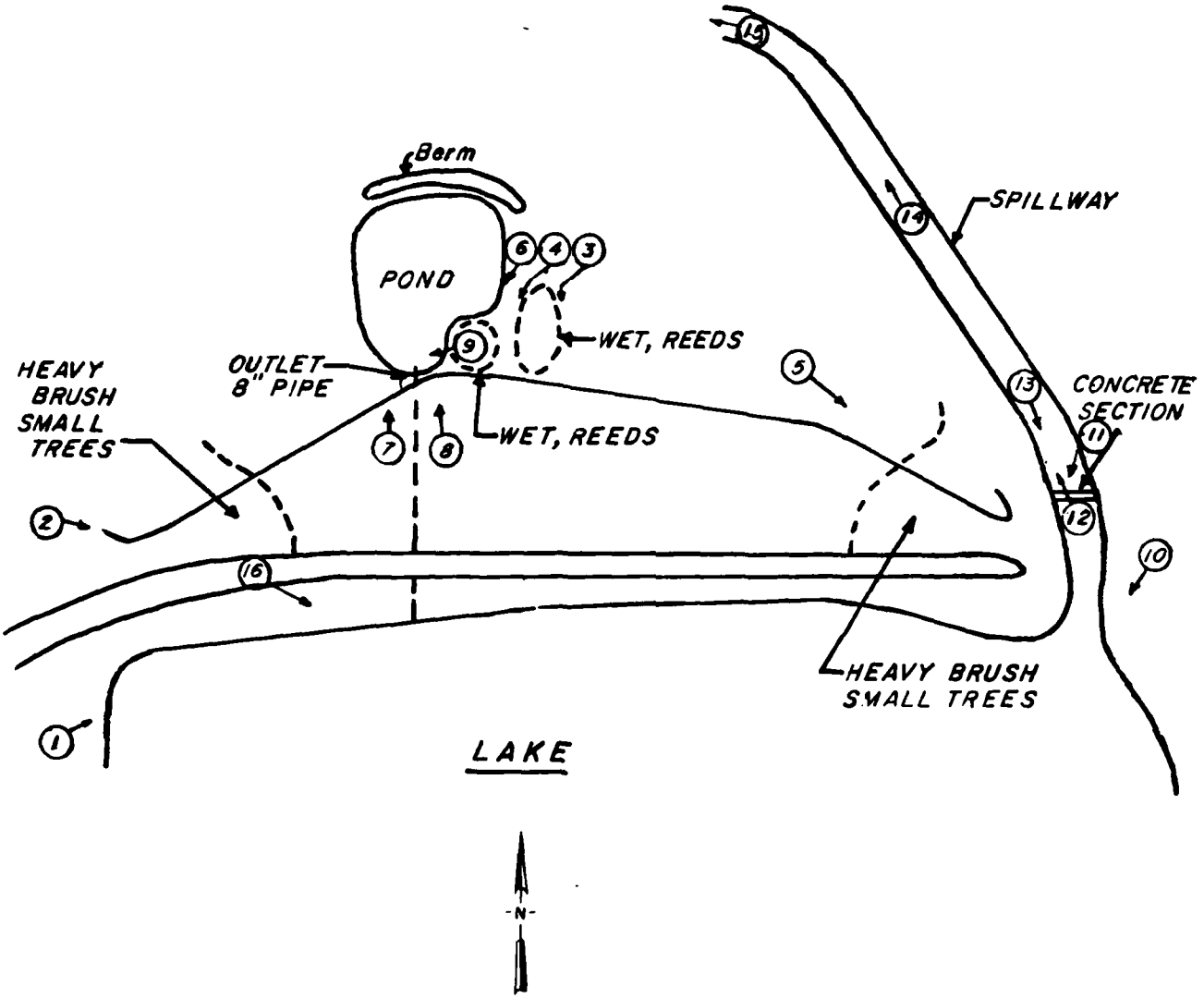


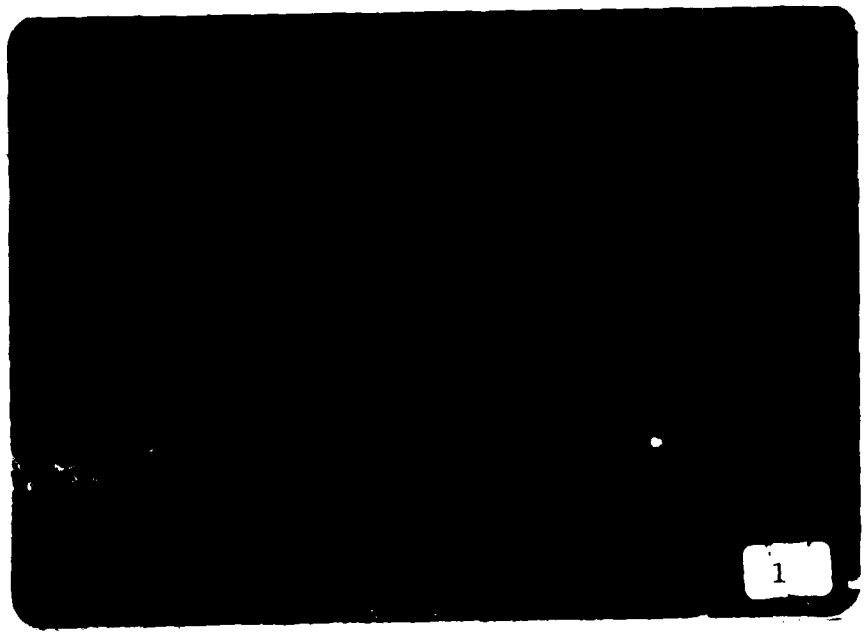
Time (hrs.)

APPENDIX D

LIST OF PHOTOGRAPHS

Photo No.	
1	Upstream Slope
2	Downstream Slope at North Abutment
3	Downstream Slope (note cattails in foreground)
4	Downstream Slope
5	Downstream Contact - East Side
6	Downstream Contact - West Side
7	Drawdown Pipe Exit and Pond
8	Reeds and Cattails Next to Pond
9	Drawdown Pipe Valve
10	Approach to Spillway Looking Upstream
11	Control Section - Spillway
12	Spillway Channel Looking Downstream
13	Control Section Looking Upstream
14	Spillway Channel Looking Downstream
15	Outlet Channel Looking Downstream
16	Lake and Watershed From Dam
17	Aerial - Downstream Face Looking South
18	Aerial - Lake and Watershed Looking South
19	Aerial - Looking West Across Dam
20	Aerial - Lake and Watershed Looking North


Berm
POND
SPILLWAY
WET, REEDS
OUTLET
8" PIPE
HEAVY
BRUSH
SMALL
TREES
WET, REEDS
CONCRETE
SECTION
HEAVY BRUSH
SMALL TREES
LAKE
-N-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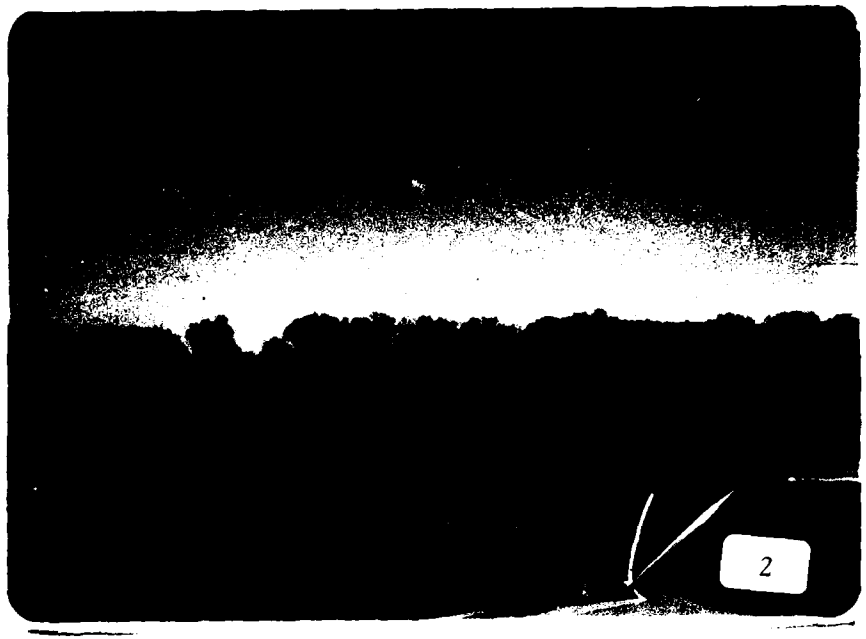
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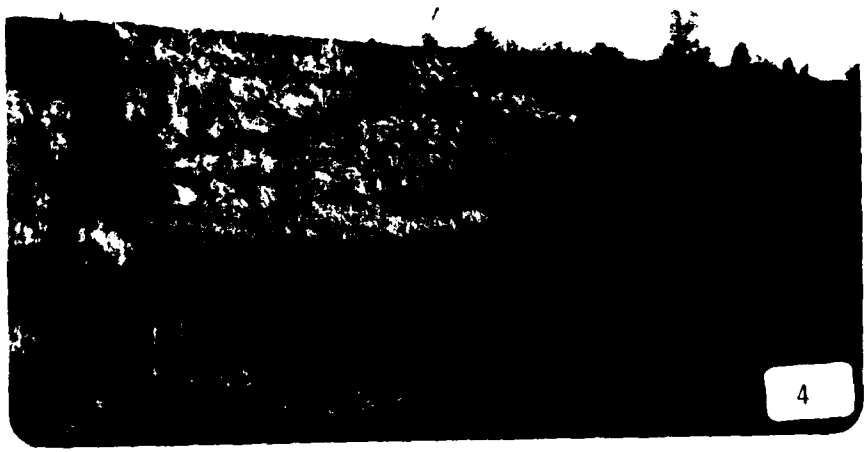

4


5


6


7


8


9

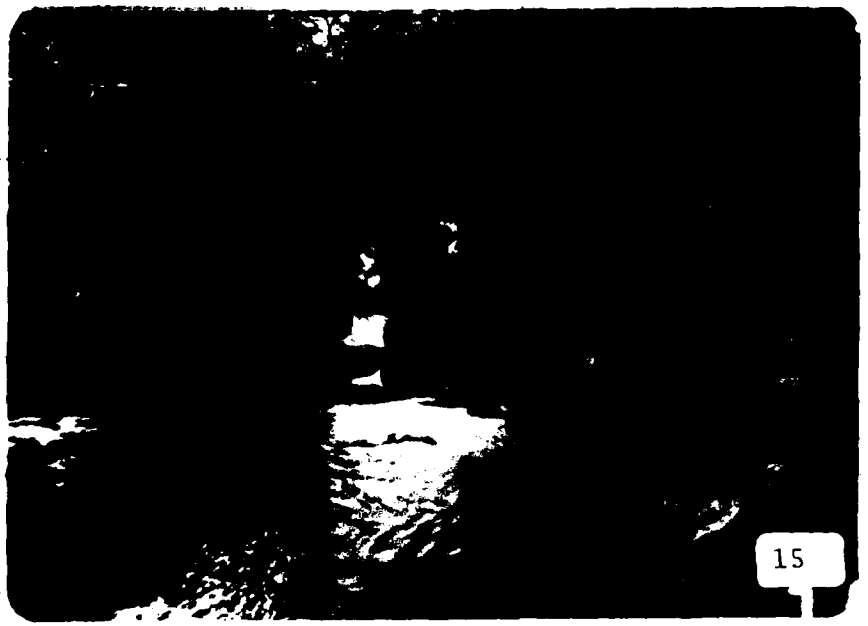

10


11


12


13


14

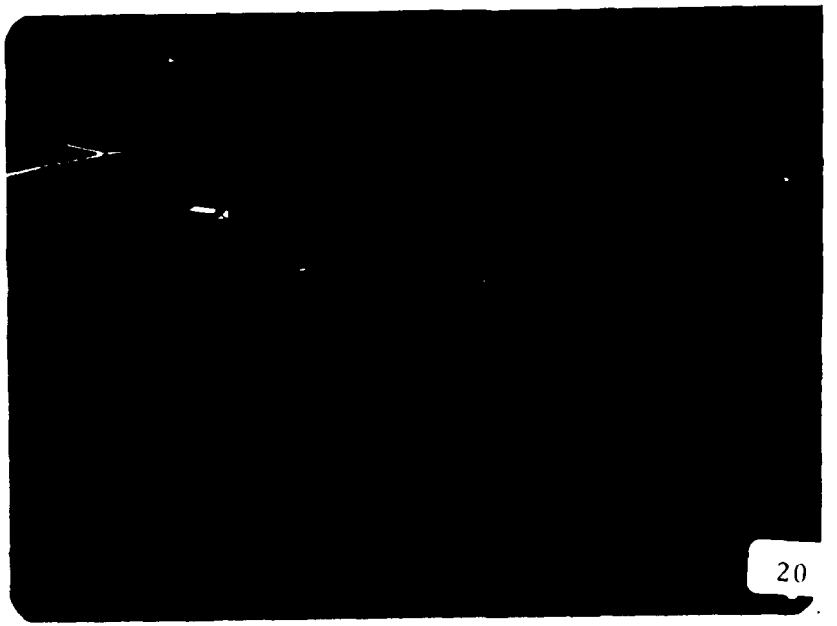

15


16


17


18


19


20